

CLASSIC PAPER

Do house officers learn from their mistakes?*

A W Wu, S Folkman, S J McPhee, B Lo

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Mistakes are inevitable in medicine. To learn how medical mistakes relate to subsequent changes in practice, we surveyed 254 internal medicine house officers. One hundred and fourteen house officers (45%) completed an anonymous questionnaire describing their most significant mistake and their response to it. Mistakes included errors in diagnosis (33%), prescribing (29%), evaluation (21%), and communication (5%) and procedural complications (11%). Patients had serious adverse outcomes in 90% of the cases, including death in 31% of cases. Only 54% of house officers discussed the mistake with their attending physicians, and only 24% told the patients or families. House officers who accepted responsibility for the mistake and discussed it were more likely to report constructive changes in practice. Residents were less likely to make constructive changes if they attributed the mistake to job overload. They were more likely to report defensive changes if they felt the institution was judgmental. Decreasing the work load and closer supervision may help prevent mistakes. To promote learning, faculty should encourage house officers to accept responsibility and to discuss their mistakes.

"The most fruitful lesson is the conquest of one's own error. Whoever refuses to admit error may be a great scholar but he is not a great learner. Whoever is ashamed of error will struggle against recognizing and admitting it, which means that he struggles against his greatest inward gain."

Goethe, *Maxims and Reflections*

Mistakes are inevitable in the practice of medicine because of the complexity of medical knowledge, the uncertainty of clinical predictions, time pressures, and the need to make decisions despite limited or uncertain knowledge. Mistakes may be particularly distressing for physicians in training because they are assuming new clinical skills and responsibilities. Mistakes can be powerful formative experiences, beneficial in some cases, harmful in others. Ideally, mistakes would be used by medical educators as teaching tools. However, while mistakes in medical practice have been discussed in essays,¹⁻⁴ anthropologic studies,⁵⁻⁷ and anecdotal accounts,^{8,9} little is known about how house officers can learn better from their mistakes.

We examined mistakes reported by house officers at three academic internal medicine training programs to address the following questions: What types of mistakes did they make? What did house officers perceive were the causes of their mistakes? How did house officers and institutions respond to mistakes? What predicted whether house officers learned from their mistakes?

SUBJECTS AND METHODS

Subjects

In May 1989 we mailed a questionnaire to 254 house officers in three internal medicine training programs associated with medical schools. Programs were located at large (>500 beds) academic tertiary care hospitals.

Procedures

Questionnaires were filled out anonymously to assure confidentiality. House officers were asked to return a postcard indicating either that they had mailed the completed questionnaire or that they did not wish to participate in the study. If the postcard was not returned, house officers received two additional mailings and a personal reminder from one of the authors. Approval for the study was obtained from institutional review boards at all three institutions.

Questionnaire

The questionnaire was developed after a review of the literature^{7,10-19} and two stages of pretesting. Subjects were asked to describe their most significant medical mistake in the last year, their response to it, and the events that followed. A mistake was defined as an act or omission for which the house officer felt responsible that had serious or potentially serious consequences for the patient and that would have been judged wrong by knowledgeable peers at the time it occurred.

Respondents first wrote a paragraph about the mistake and then answered questions about the age and prognosis of the affected patient, adverse patient outcomes, and perceived causes of the mistake.

In describing responses to the mistake, house officers answered questions about the degree to which they accepted responsibility for the mistake, their emotional response to the mistake, discussions about the mistake with others, the institutional response to the mistake, and changes in practice due to making the mistake.

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Table 1 Internal consistency reliability coefficients, means, and SDs for scores converted to a scale of 0 to 100

Scale	No of items	Cronbach's α	Mean	(SD)
<i>Causes:</i>				
Inexperience	3	0.50	66.1	(26.4)
Overload	2	0.58	45.2	(30.4)
Judgment/complexity	4	0.68	41.4	(27.7)
<i>Physician response:</i>				
Emotional distress	4	0.79	71.3	(23.7)
Accepting responsibility	3	0.45	54.5	(22.3)
<i>Institutional response:</i>				
Judgmental	2	0.30	26.7	(22.9)
<i>Changes in practice:</i>				
Constructive changes	9	0.74	52.2	(20.0)
Increased information seeking	5	0.82	48.5	(26.3)
Increased vigilance	4	0.67	57.3	(24.4)
Defensive changes	2	0.57	17.7	(18.9)

Questions used four-point Likert-type and categorical response formats. Respondents were also encouraged to write comments at the end of the questionnaire.

Scales

We grouped items on the questionnaire into scales representing meaningful concepts on the basis of factor analysis and consensus of the authors' judgment. Each scale score was created by summing the responses to the items it included.

Causes of the mistake were described by three scales: inexperience (three items), job overload (two items), and case complexity (four items). *Responsibility* for the mistake was measured with three items from the "accepting responsibility" subscale of the Ways of Coping Scale developed by Folkman and Lazarus.²⁰ *Emotional distress* in response to the mistake was measured with four items. The extent to which the institutional response was *judgmental* was measured with two items. The *extent of discussion* was measured by summing affirmative responses to items that asked whether the physician discussed the mistake with the supervising attending physician, another medical person, the patient or family, or at a conference.

Learning from the mistake was measured by two scales that asked house officers how they changed their practices due to the mistake. A scale of constructive changes in practice contained nine items. A scale of defensive changes contained

two items. It should be noted that constructive and defensive changes measure separate concepts rather than polar opposites of the same scale. Therefore, a house officer might report both constructive and defensive changes in practice after making a mistake.

Means, SDs, and internal consistency reliability coefficients (Cronbach's α) for each of these scales are shown in table 1. Relatively large SDs for the overload, judgmental, and defensive scales reflect skewed score distributions. The non-normal distributions make the α coefficient difficult to interpret. To facilitate comparison of the different scale scores, scores were transformed linearly to a scale of 0 through 100, with 0 indicating the lowest and 100 indicating the highest possible score.

Analysis

Analysis was conducted in two stages. In the first stage, two-sample *t* tests and one-way analyses of variance were used to test the relationship between the dependent variables (constructive change and defensive change) and categorical independent variables (house officer gender and year of residency training; institution and setting of the mistake; patient age group, previous functioning, and life expectancy; whether or not there was a serious outcome; and extent of discussion). Simple correlations were used to evaluate the relationship between the dependent variables and continuous independent variables (scales for causes of the mistake, accepting responsibility for the mistake, and institutional response to the mistake).

In the second stage, variables that had been found to be related to the dependent variables at $p < 0.15$ were included in two multiple linear regression equations to test their independent relationship to (1) constructive changes in practice and (2) defensive changes in practice.

RESULTS

Characteristics of respondents

Of the 254 residents surveyed, 114 (45%) responded by reporting a mistake and completing the questionnaire. An additional 56 residents (22%) returned a postcard acknowledging receipt but declining to complete the questionnaire. The remaining 33% did not respond.

Our study group comprised the 114 respondents who completed the questionnaire. Because the results did not differ by site, we present only aggregated results. 33% of the subjects were women. 36% of the respondents were interns, 32% were junior residents, and 32% were senior residents. The distributions of gender and year of training were similar among respondents and non-respondents.

Table 2 Types of mistakes made by the 114 survey respondents

Type of mistake	No (%) of total cases	Examples	Patient outcomes*
Errors in diagnosis	38 (33)	Failed to diagnose small-bowel obstruction in a patient with ascites Failed to examine and diagnose fracture in a "crack" cocaine user	Death Delayed treatment
Errors in evaluation and treatment	24 (21)	Treated malignant hypertension on the ward instead of in the intensive care unit Incomplete débridement of a diabetic foot ulcer	Stroke Amputation
Errors in prescribing and dosing	33 (29)	Did not read syringe and gave 50 times the correct dose of levothyroxine	None apparent
Procedural complications	13 (11)	Inadvertently stopped asthma medication at the time of hospitalization Removed pulmonary artery catheter with the balloon inflated Placed central line without a follow-up roentgenogram	Respiratory failure Small amount of bleeding Fatal tension pneumothorax
Faulty communication	6 (5)	Failed to document "do not resuscitate" order in chart and failed to inform spouse Failed to obtain consent before central line placement	Resuscitation was performed against the patient's wishes No informed consent for a procedure that had a fatal complication

*Cause and effect cannot be determined.

Table 3 Summary of 114 mistakes and outcomes reported by house officers

Error	Patient outcome
<i>Diagnostic errors</i>	
Misdiagnosed hypertension-induced pulmonary edema as pleural effusion	None
Failed to diagnose cryptococcoma on roentgenogram	Death
Possibly failed to diagnose AIDS adrenal insufficiency	Death
Failed to diagnose small bowel obstruction in a patient with ascites	Death
Missed physical findings because of concentration on abdomen	None
Failed to diagnose gastrointestinal bleeding	Death
Failed to place a nasogastric tube and to diagnose gastrointestinal bleeding	Stroke
Did not check chest roentgenogram in a patient with pneumothorax	Delayed diagnosis
Failed to recognize signs of cardiac disease in a patient with AIDS-related complex	Delayed treatment
Misread electrocardiogram and treated a patient with verapamil	Hypotension
Failed to note acidosis in a hypotensive patient after a procedure	None
Failed to recognize tension pneumothorax at cardiac arrest	Death
Failed to examine and diagnose pneumothorax in an intubated patient	Delayed therapy
Failed to diagnose eclampsia	Death
Misdiagnosed ovarian cyst as pelvic inflammatory disease	None
Missed signs of sepsis in an elderly woman after an invasive procedure	None
Failed to examine and diagnose fracture in a "crack" cocaine user	Delayed treatment
Did not recognize respiratory acidosis	Death
Failed to diagnose hypoxia in an agitated AIDS patient	Delayed therapy
Did not examine and failed to diagnose cavernous sinus syndrome	Delayed diagnosis
Failed to consider tension pneumothorax at cardiac arrest	Death
Failure to diagnose sepsis in a lung cancer patient	Death
Missed hemothorax on chest roentgenogram	Death
Did not consider right ventricular infarct during cardiac arrest	Death
Failure to notice neurological disease in an asthmatic outpatient	Delayed diagnosis
Missed electrocardiogram changes in an elderly woman with back pain	Delayed care
Failed to order arterial blood gas tests and to recognize diabetic ketoacidosis	Delayed treatment
Failed to diagnose cholangitis and impending sepsis	Delayed treatment
Presumed a diagnosis of <i>Pneumocystis carinii</i> pneumonia in a patient with sepsis	Death
Treated cardiac disease as sepsis and induced congestive heart failure	Death
Did not recognize falling partial thromboplastin time as a sign of recurrent pulmonary embolism	Death
Failed to collect sputum and to diagnose tuberculosis	Disseminated tuberculosis, death
Misdiagnosed tubal pregnancy as ulcer disease	None
Missed electrocardiogram changes and failed to diagnose acute myocardial infarction	None
Failed to diagnose atypical vertebral aneurysm	None
Failed to do lumbar puncture and to diagnose cryptococcal meningitis	Death
Misinterpreted coagulation study	Overdose of sodium warfarin
Failed to obtain correct chief complaint of headache before dialysis	Death
<i>Errors in evaluation and treatment</i>	
Conservative treatment of an overdose of sodium warfarin	Hematoma
Inadequate evaluation of status of gastrointestinal bleeding	Transfer to ICU
Failed to administer nitroprusside in aortic dissection	Death
Failed to perform anticoagulation in a patient with cardiomyopathy	Stroke
Delayed antibiotic therapy in a patient with ascites	Death
Delayed central line placement	Prolonged stay
Slow response to a call to see a patient after a liver biopsy	Surgery
Insufficient fluids administered to a patient with probable pancreatitis	Hypotension, transfer to ICU
Failed to treat hypoglycemia in AIDS	Fatal seizure
Did not evaluate decreased urine output in a patient receiving chemotherapy	Drug toxicity
Delayed penicillin treatment of suspected meningococcus infection	None
Delayed electrocardiogram in a patient with possible myocardial infarction	Transfer to ICU
Did not consider thrombolytic therapy in a patient with acute myocardial infarction	Possible loss of myocardial function
Failed to treat an episode of ventricular tachycardia in chronic obstructive pulmonary disease	None
Failed to treat coronary artery disease in a patient with vasculitis	Death
Misinterpreted admission arterial blood gas result in pneumonia	Death
Delayed seeing a patient with acute congestive heart failure	None
Failed to make a timely evaluation of hypotension in an AIDS patient	Death
Removed Foley catheter too early from transplantation patient	None
Induced renal failure and congestive heart failure during workup of a hypoglycemic seizure	Death
Hesitated to perform a brain biopsy in an AIDS patient	Delayed treatment
Incomplete débridement of a diabetic foot ulcer	Amputation
Treated malignant hypertension on the ward instead of in the ICU	Stroke
Scheduled a treadmill test for a patient before ruling out myocardial infarction	Risked extending infarct
<i>Errors in prescribing and dosing</i>	
Prescribed nonsteroidal anti-inflammatory agents for a patient with renal insufficiency	Worsened renal function
Nearly gave an overdose of labetalol	None
Prescribed a relative overdose of glyburide	Hypoglycemia
Failed to decrease the verapamil dose for renal function	Fatal cardiac toxicity
Wrote a prescription for an overdose of phenytoin	Hospitalized for toxicity
Gave indomethacin to a dehydrated patient	Renal failure
Failed to check the salislate level	Renal failure, dialysis
Gave an extra dose of sustained-release verapamil for hypertension	Heart block, pacemaker
Gave esmolol to a patient after a myocardial infarction	Persistent bradycardia, extended infarct
Wrote a prescription for 10 times the correct dose of intravenous heparin	None
Gave a cancer patient an overdose of narcotics	Respiratory failure, transfer to ICU
Did not read syringe and gave 50 times the correct dose of levothyroxine	None

Table 3 continued

Error	Patient outcome
Failed to notice an elevated creatine kinase value in a patient receiving lovastatin	Myalgia
Gave an overdose of intrathecal amphotericin	None
Inadvertently discharged a patient without nitroglycerin	Readmission
Forgot to order potassium replacement for a patient after a myocardial infarction	Death
Ordered potassium via bolus instead of slow infusion	None
Failed to notice an intern's incorrect insulin order	Hypoglycemia
Failed to notice an intern's incorrect order for verapamil	Death
Ordered phenothiazine for haloperidol overdose	None
Treated 4-year-old with tetracycline for a dog bite	Possible tooth staining
Prescribed verapamil to a patient receiving beta-blocker therapy	None
Inadvertently stopped asthma medication at the time of hospitalization	Respiratory failure, transfer to ICU
Increased the rate of insulin drip unaware that the concentration had been changed	Hypoglycemia
Treated hypokalemia with oral replacement	Fatal arrhythmia
Insufficient potassium replacement in a patient receiving amphotericin	Death
Incorrect dosing interval for antibiotic	None
Prescribed lorazepam to a patient with respiratory muscle weakness	Death
Wrote a prescription for an overdose of gentamicin (not given)	None
Ordered 10 times the correct dose of levothyroxine	Prolonged hospital stay
Exacerbated ICU psychosis with lorazepam	Myocardial infarction
Gave captopril to a patient with a documented allergy	None
Gave ampicillin to a patient allergic to penicillin	Rash
<i>Procedural complications</i>	
Failed to heed a suggestion to reposition central venous catheter	Endocarditis
Removed pulmonary artery catheter with the balloon inflated	Small amount of bleeding
Pneumothorax from central line	Chest tube placed
Unable to place central line	Missed antibiotic doses
Blood return during lumbar puncture	None
Pneumothorax during thoracentesis	Chest tube placed
Perforated bowel during paracentesis	Change in therapy
Lacerated liver during liver biopsy	Death
Perforated subclavian vein during central line placement	Death
Induced hemoptysis during thoracentesis	None
Placed central line without a follow-up roentgenogram	Fatal tension pneumothorax
Perforated ventricle during pacemaker placement	Death
<i>Faulty communication</i>	
Failed to note incorrect arterial blood gas reading by intern	Premature discharge
Failed to follow the attending physician's protocol for gastrointestinal bleeding	None
Failed to obtain consent before central line placement	No informed consent for a procedure that had a fatal complication
Accepted misinformation that the patient was not to be resuscitated	Death
Failed to document "do not resuscitate" order in chart and failed to inform spouse	Resuscitation was performed against the patient's wishes
Did not assert authority in resuscitation with questionable intubation	Death

AIDS=acquired immunodeficiency syndrome; ICU=intensive care unit.

Types of mistakes

Types and frequency of mistakes are summarized in table 2. The most frequently reported type of mistake was a missed diagnosis (33%). In one typical case, a house officer failed to recognize congestive heart failure in a patient with human immunodeficiency virus disease with severe dyspnea.

Errors in evaluation and treatment were reported in 21% of cases. For example, one resident noted but failed to treat profound hypoglycemia in a patient with the acquired immunodeficiency syndrome admitted with neutropenia and presumed sepsis. The patient had a seizure and died soon thereafter.

House officers reported errors in prescribing and dosing of drugs in 29% of cases. One resident missed an intern's drug dosing error in an elderly woman with congestive heart failure who was well known to him from previous admissions. "I approved the intern's admission orders without noting a significant error," in which an 80 mg dose of a cardiac medication was transcribed as 180 mg. The patient was found dead 2 hours after her first dose.

Errors ascribed to faulty communication were described in 5% of cases. In one such case, a resident accepted misinformation from the emergency department physician that a patient being admitted was not to be resuscitated. "I subsequently found out from the patient's family and personal physician that the patient was *not* a 'no code.' At that point in time the patient had not been treated aggressively and died 24 hours later."

Examples of procedural complications, described in 11% of cases, and other types of mistakes are given in table 2; a brief summary of all of the mistakes is presented in table 3.

Outcomes of mistakes

In response to the question "What adverse effects did the mistake have for the patient?", 90% of residents reported that patients had significant adverse outcomes following mistakes. These included physical discomfort (32%), emotional distress (27%), additional therapy (25%), additional procedure (13%), prolonged hospital stay (24%), and death (31%). Mistakes often had multiple adverse outcomes. For 10% of patients, no adverse outcome was attributed to the mistake. A brief summary of the reported outcomes of the mistakes is included in table 3.

Causes of mistakes

The causes of mistakes reported by house officers varied (table 4). House officers usually attributed mistakes to more than one cause: 54% reported that mistakes were caused in part because they did not know information they should have known (e.g. being unaware of the significance of a prolonged episode of ventricular tachycardia); 51% reported "too many other tasks" (e.g. one resident neglected to continue to administer a required medication, being "too busy with other sick patients and supervising interns and students"); 41% reported fatigue (e.g. after inadvertently ordering potassium

Table 4 Perceived causes of mistakes

Cause	No (%) [*]
Inexperience	
Should have known information	62 (54)
Not enough experience	48 (42)
Did not ask for advice	38 (33)
Job overload	
Too many other things to take care of	58 (51)
Fatigued	47 (41)
Faulty judgment in complex case	
Missed warning signs	57 (50)
Atypical presentation	44 (39)
Very complex case	43 (38)
Hesitated too long	36 (32)

^{*}Includes those who agreed strongly or somewhat. Respondents could agree with more than one cause.

replacement as a bolus, one resident commented, "It was 3 am and I'm not sure I was completely awake").

Circumstances of mistakes

The mistakes occurred during medical school in 3% of cases, during the first year of residency in 53% of cases, during the second year of residency in 36% of cases, and during the third year of residency in 9% of cases. The mistakes happened with inpatients in 77% of cases, emergency department patients in 14% of cases, and outpatients in 9% of cases. The patients involved in the mistakes were less than 18 years old in 1% of cases, 18–64 years in 60% of cases, and 65 years or older in 39% of cases. House officers estimated the life expectancy of patients to be less than 1 month in 10% of the cases, 1–6 months in 22% of the cases, 6–12 months in 18% of the cases, and greater than 12 months in 50% of the cases.

House officers' responses to mistakes

House officers reported discussing the mistake with the supervising attending physician in only 54% of cases. However, 88% of house officers discussed the mistake with another physician who was not in a supervisory capacity. House officers discussed the mistake with the patient or patient's family in only 24% of cases; 58% of house officers reported talking to a non-medical person about the mistake. Only 5% of house officers did not tell anyone about the mistake. On a scale ranging from 0 to 100 for extent of discussion, the mean score was 52.5 (SD 22.8). On average, house officers discussed the mistake with two of the following: their supervising attending physician, another medical person, the patient or family, or at a conference.

Most house officers were willing to accept responsibility for their mistakes. Subjects' responses included "promising to do things differently the next time" in 76% of cases, "criticizing or lecturing oneself" in 62% of cases, and "apologizing or doing something to make up" in 21% of cases. On a scale ranging from 0 to 100 for accepting responsibility, the mean score was 54.5 (SD 22.3).

House officers experienced emotional distress in reaction to the mistakes. After a fatal mistake involving a young patient, one house officer wrote: "This event has been the greatest challenge to me in my training." They felt remorseful in 81% of cases, angry at themselves in 79% of cases, guilty in 72% of cases, and inadequate in 60% of cases. On a scale that ranged from 0 to 100, the mean level of distress was 71.3 (SD 23.7). The correlation between distress and accepting responsibility was 0.58 ($p < 0.0001$). 28% of house officers feared negative repercussions from the mistake.

A few house officers reported persistently negative psychological impact of mistakes. After a mistake caused the death of a patient, one house officer commented, "This case has made me very nervous about clinical medicine. I worry now about

Table 5 Changes in practice described by respondents following mistakes (n=114)

Change in practice	No (%) [*]
<i>Constructive changes:</i>	
Increased information seeking	
Seek more advice	71 (62)
Ask peers	68 (60)
Ask superiors	64 (56)
Read	62 (54)
Ask for references	30 (26)
Increased vigilance	
Pay more attention to detail	93 (82)
Personally confirm data	82 (72)
Change organization of data	59 (52)
Trust others' judgment less	56 (49)
<i>Defensive changes:</i>	
Keep mistakes to self	15 (13)
Avoid similar patients	7 (6)

^{*} Includes those who agreed strongly or somewhat. Respondents could agree with more than one change.

all febrile patients since they may be on the verge of sepsis." For another house officer, a missed diagnosis made him reject a career in subspecialties that involve "a lot of data collection and uncertainty."

Institutional responses to mistakes

Mistakes were discussed in attending rounds in 57% of cases and at the morning report or morbidity and mortality conference in 31% of cases. However, house officers stated that, in about half of these conferences (48%), "the tough issues were not addressed." One house officer believed "the key issues were ignored by the morbidity and mortality committee, i.e. being overworked, having too many patients to care for at one time."

House officers felt that the hospital atmosphere inhibited them from talking about the mistakes in 27% of cases and that the administration was judgmental about the mistakes in 20%. One house officer felt that public discussion is counterproductive: "Training programs do not sympathize or help one learn from one's mistakes. Instead, the administration is usually critical and often ostracizes the individual." In contrast, although another house officer was initially reluctant, she found discussing her mistake to be a positive experience: "Presenting this case at intern's report was difficult—I felt under a lot of scrutiny from my peers. In the end, I felt as though I had gotten more respect from presenting this kind of case rather than one where I had made a great diagnosis."

Changes in practice

Almost all residents (98%) reported some change in practice in response to their mistakes. The most frequently reported changes were paying more attention to detail (82%), confirming clinical data personally (72%), and seeking advice (62%). Most residents (98%) reported at least one constructive change. Only 18% reported one or more defensive changes. A summary of constructive and defensive changes reported by house officers is shown in table 5. In addition, 26% of respondents described ordering more tests as a result of their mistakes. In review, the authors believe that ordering more tests might have prevented the mistake in most cases. Thus, we did not group this item with defensive changes.

Factors relating to reported changes in practice

We examined how predictor variables—physician characteristics, patient characteristics, type and seriousness of the mistake, causes of the mistake, and responses to the mistake by the physician and the institution—were related to reported constructive and defensive changes in practice.

Table 6 Predictors of constructive changes in practice

Predictor	β	p value*
Female physician	7.43	<0.05
Serious outcome for patient†	3.46	NS
Mistake caused by inexperience‡	0.23	<0.001
Mistake caused by job overload‡		<0.01
Mistake caused by case complexity‡	0.20	<0.001
Accepted responsibility‡	0.23	<0.01
Greater extent of discussion§	0.25	<0.01
Institution judgmental†	0.01	NS
R ²	0.49	
Adjusted R ²	0.44	

*NS=not significant.

†The following scale was used for causes of the mistake, judgmental institutional response, and constructive change; 0, disagree strongly; 33, disagree somewhat; 67, agree somewhat; and 100, agree strongly.

‡The following scale was used for accepting responsibility: 0, not at all; 33, somewhat; 67, quite a bit; and 100, a great deal.

§The following scale was used for the extent of discussion (with the supervising attending physician, another medical person, the patient or family, and/or at a conference): 0, none of these; 25, one of these; 50, two of these; 75, three of these; and 100, all four of these.

In univariate analysis, constructive changes in practice were significantly associated ($p < 0.05$) with female gender, serious outcome, inexperience, or case complexity as causes of the mistake, accepting responsibility for the mistake, and extent of discussion of the mistake. Defensive changes in practice were significantly associated with house officers' perceptions of job overload as a cause of the mistake and perceptions that the institution responded judgmentally. Changes in practice were not significantly related to age, functional level, or prognosis or to physician year of training or institution.

In multivariate analysis, reported constructive changes in practice were associated with several independent predictors (table 6). Residents were more likely to report constructive changes if the mistake was caused by faulty judgment in a complex case or by inexperience, but they were less likely to do so if they perceived that the mistake was caused by job overload. Physicians who responded to the mistake with greater acceptance of responsibility and more discussion were also more likely to report constructive changes. The independent variables shown in table 6 were associated with 44% of the variance in constructive changes. Constructive change is reported on a scale of 0 to 100, with 33 equivalent to an average response of "disagree somewhat" and 67 equivalent to an average response of "agree somewhat." The independent effect of a predictor variable on constructive change can be calculated by multiplying the β coefficient by the difference in score or category for that predictor variable, as noted in table 6.

Defensive changes in practice were more likely if there was a judgmental institutional response to the mistake ($\beta = 0.37$, $p < 0.001$). In multivariate analysis, the model was associated with 29% of the variance in defensive changes. However, the small number of respondents reporting defensive changes gave this analysis relatively little power to detect significant predictors.

COMMENT

Mistakes are inevitable in clinical medicine, given its inherent uncertainty and complexity and the need to make decisions despite limited information. Because house officers are taking on new clinical responsibilities, they may be particularly likely to make mistakes.

This study suggests several ways to help residents learn from their mistakes and institute constructive changes in practice. First, house officers should be encouraged to accept responsibility for their mistakes. In our study, residents who

reported accepting responsibility reported constructive changes in practice more often than residents who did not accept responsibility. However, accepting responsibility for mistakes was also strongly associated with emotional distress. For example, one resident described persistent feelings of guilt and shame after inappropriate management of a diabetic foot ulcer led to an amputation. Thus, supervising physicians who encourage house officers to accept responsibility for their mistakes need to respond sensitively to the distress those house officers may experience.

Second, house officers should be encouraged to discuss their mistakes with attending physicians. While house officers candidly described their mistakes in the questionnaire, barely half had told their attending physicians about them, although the attending physician is legally and ethically responsible for patient care. Several house officers expressed the desire for helpful discussion. One resident wanted more discussion so that "some of the unsaid horrors of our experiences can be discussed and dealt with." Another wrote, "I was very disturbed that there was never really an opportunity to discuss the mistake . . . I was also very frightened by the impact that carelessness or ignorance on my part could have on someone else's life." In training programs, mistakes are traditionally discussed at conferences and rounds. In this study, however, when their mistakes had been discussed in a conference, half of the house officers said that the "tough issues were not addressed." In non-medical specialties, avoidance of important issues may be a common response to mistakes. For example, in psychiatry, suicide review conferences often transform "negative evidence into a positive display of an attending's skill."²¹ In surgery, a morbidity and mortality conference consists of "ceremonial apologies" by attending physicians.⁶ The limited role of residents in these proceedings may preclude useful discussion. Future studies should explore why house officers are reluctant to tell their supervisors about their mistakes and how to encourage fruitful discussion.

Because mistakes may have harmful consequences for patients, it is important to try to reduce their frequency and severity. Our findings regarding the reported causes of mistakes suggest specific strategies for preventing mistakes. First, more active supervision may prevent some mistakes or mitigate their adverse effects. Senior physicians should be more available for critical decisions about patient care, especially in complex cases that require more mature clinical judgment. One officer complained, "As an intern, I couldn't—and didn't—know enough to manage the case." Another speculated, "If I had had more attending support all along with this patient, the diagnosis would have been made much sooner and the patient might have survived."

Attention must be given to house officer work load. McCue²² has suggested that sleep deprivation during training may teach house officers to tolerate and rationalize unnecessary errors. In our study, house officers reported that job overload played a part in 65% of mistakes. Moreover, house officers who reported being fatigued or having too many tasks to perform were less likely to seek information following a mistake. Such information seeking might help prevent future mistakes.²³

Disclosure of mistakes to patients or their families is a difficult issue. In our study, such disclosure was reported by fewer than one quarter of house officers. This finding is consistent with reports suggesting that physicians are reluctant to tell patients about mistakes.^{5, 24-25} Legal and ethical experts, however, suggest that a patient generally should be told about a mistake.^{4, 26-28} Disclosure of a mistake may also foster learning by compelling the physician to acknowledge it truthfully. Indeed, our study suggests that accepting responsibility may precede learning from a mistake. Finally, Hilfiger⁸ argues that disclosing a mistake to the patient may be the only way for the physician to achieve a sense of absolution. However, telling patients about mistakes may be difficult